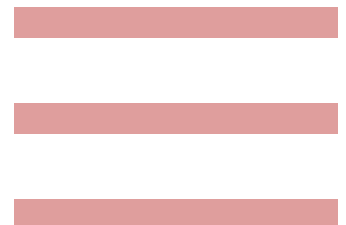


Avian Influenza: The Hunt and Peck for Answers



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Purpose

This paper briefly explores the situation regarding the current bird flu outbreak and the role the waste management industry may play in successfully managing infected carcasses and associated materials, such as feces, bedding, and feed. This paper also provides guidance on the protection of waste management employees involved in the treatment, transportation, and disposal of infected carcasses from an outbreak.

Bird Infection

Avian influenza is an infectious disease in birds caused by type A strains of the influenza virus. The disease occurs naturally among wild birds where it is carried in their intestines without apparent harm. However, avian influenza is very contagious among birds and can make some domesticated birds (e.g., chickens, ducks, and turkeys) very sick and kill them. Infected birds shed the influenza virus in their saliva, nasal secretions, and feces. Susceptible birds become infected when they contact contaminated secretions or excretions, or surfaces contaminated with secretions or excretions from infected birds.



Researchers in the field are testing wild birds to determine whether they are carrying avian influenza.

In poultry, avian influenza causes two distinctly different forms of the disease – one non-lethal and the other highly lethal. The highly lethal form (“high pathogenic avian influenza”) is difficult to miss because of the sudden onset of the disease, rapid spread throughout a flock, and high mortality rates (almost 100 percent) within 48 hours. With the highly lethal form, the virus not only affects the respiratory tract, but also invades multiple organs and tissue resulting in massive internal hemorrhaging.

There are many different forms of type A influenza viruses infecting birds worldwide. Until recently, evidence suggested that wild waterfowl introduced non-lethal viruses to poultry flocks, but did not directly carry or spread the highly lethal viruses. However, at least some species of migratory waterfowl are now thought to be carrying the highly lethal form and introducing the virus to new geographical areas located along their migratory routes. Besides being highly contagious among poultry, avian influenza viruses are readily transmitted from farm to farm by the movement of live birds, people’s contaminated shoes and clothing, and contaminated vehicles, equipment, feed, and cages.

Countries Affected by Bird Influenza

Because avian influenza occurs naturally in wild birds, the virus has been, and continues to be, a threat to domestic poultry. The more highly publicized outbreak of avian influenza began in Southeast Asia in mid-2003 of the highly lethal H5N1 strain. Since its first outbreak in Pacific countries, H5N1 has spread to 48 countries in Europe, Asia, Africa, and the Middle East (see map page 2). The further spread of the virus along the migratory routes of wild waterfowl is anticipated and scientists predict that the H5N1 virus may reach the United States by the end of 2006.

Human Infection

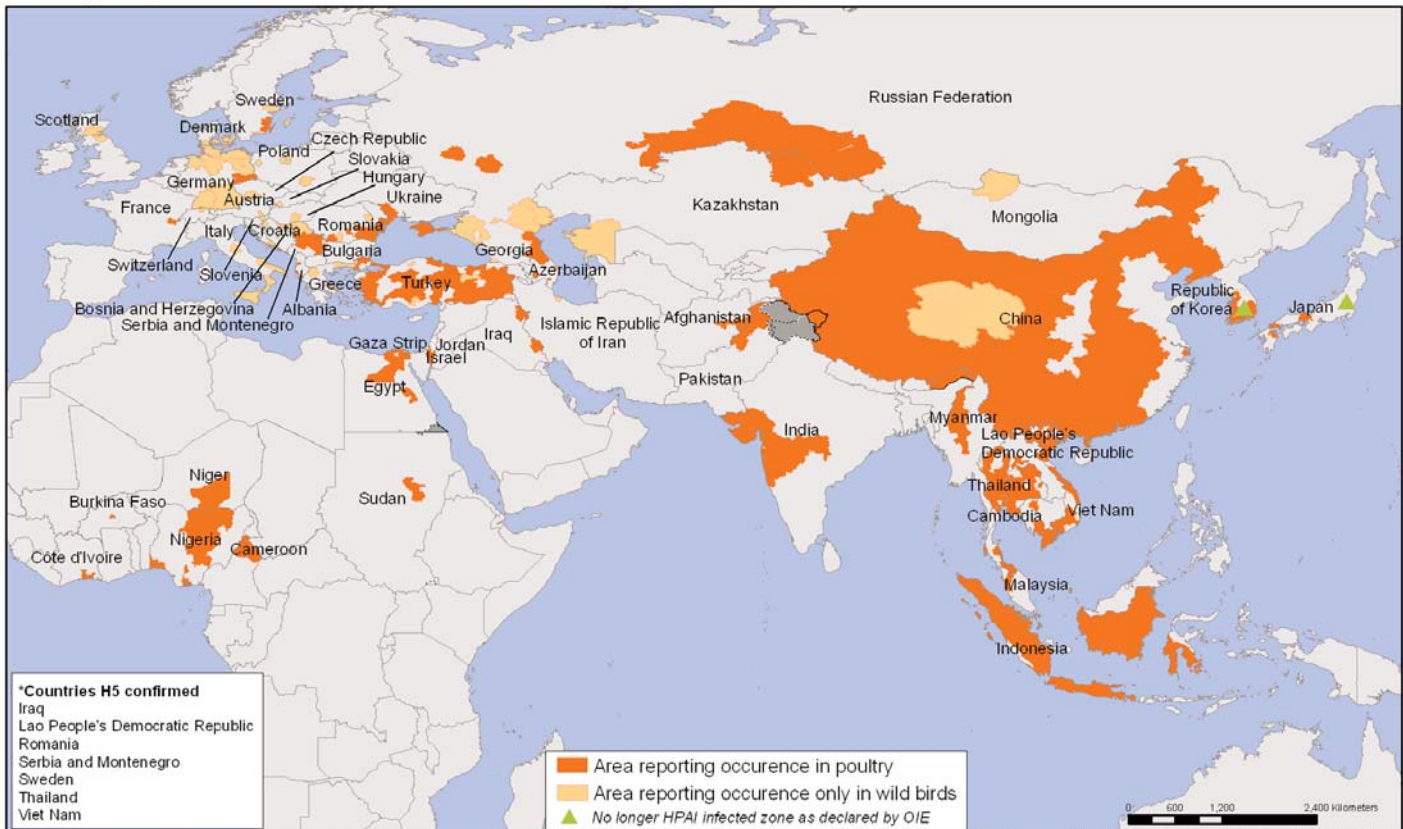
To date, the evidence indicates that close contact with diseased birds is the principal source of human infection with the H5N1 virus. Human exposure to the virus includes slaughtering, defeathering, butchering, or preparing infected birds for consumption. In a few cases, exposure to chicken feces when children played in an area frequented by free-ranging poultry is thought to have been the source of infection.

Influenza viruses are typically species-specific and rarely jump species to infect another species. However, the World Health Organization (WHO) reports that more than 200 people in 10 countries have been infected with the H5N1 strain with more than half dying from the infection.

At present, H5N1 avian influenza remains largely a disease in birds. Furthermore, the spread of the virus from person-to-person has been limited and has not contin-



The World Health Organization is playing a lead role in monitoring and containing the spread of avian influenza.



***Countries H5 confirmed**
 Iraq
 Lao People's Democratic Republic
 Romania
 Serbia and Montenegro
 Sweden
 Thailand
 Viet Nam

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Organisation for Animal Health (OIE) and national governments
 Map Production: Public Health Mapping and GIS
 Communicable Diseases (CDS) World Health Organization

ued beyond two people. Predicting if and when the H5N1 virus may readily spread among humans is not possible. However, experts from around the world are watching the situation in Asia, Africa, and Europe and are preparing for the possibility that the virus may begin to spread more easily and widely from person-to-person.

The H5N1 virus that causes human illness and death is resistant to the two antiviral vaccines commonly used for influenza. Two other antiviral medications may work to treat the H5N1 virus, but additional research is needed to demonstrate their effectiveness. Currently, there is not a commercially available vaccine to protect humans against the H5N1 virus. However, recent clinical trials conducted by the National Institutes of Health have shown that high doses of an experimental H5N1 avian influenza vaccine can induce immune responses in healthy adults that would protect them from the virus. Additionally, the WHO has developed and made publicly available a number of vaccine strains that can potentially induce an immune response.

Management of Infected Birds*

Because the H5N1 virus is a highly contagious disease in birds, immediate culling of infected and exposed birds is the first line of defense for the protection of human health and the reduction of the further spread of the virus to other birds. Past cases of bird flu, which were not highly pathogenic, in the U.S. have resulted in hundreds of thousands of birds in Delaware, Pennsylvania, and Texas being destroyed and disposed of. The current outbreak of the H5N1 virus has prompted the killing and disposal of more than 25 million birds in Asia. In addition, the agricultural setting may have materials containing the influenza virus (e.g., coops, feces, and bedding) that require proper decontamination or disposal to prevent the spread of the disease.

**This paper does not make judgments about carcass management options because when, and if, avian influenza is detected the solid waste management industry will need to evaluate how they want to participate in the management of infected materials based on their abilities to provide services, protect workers, and limit liabilities. In addition, this paper does not include a discussion on experimental technologies or technologies currently in limited commercial use.*

Disposal Options

Because of the potentially large number of birds that may need to be disposed of if an avian influenza outbreak occurs in the U.S., a single management option may not be viable or available in affected areas. According to the World Organization for Animal Health, the available disposal technologies that will inactivate avian influenza include: rendering; incineration (fixed, air curtain, and municipal); in-house composting, on-site burial; and municipal solid waste landfills. Each of the disposal technologies in which waste management companies may be involved is described below along with favorable and constraining considerations for each.

Fixed Incinerators

Fixed incinerators are typically established at an industrial facility for the destruction of waste products such as hazardous or medical waste. In most cases, fixed incinerators have limited capacity. The majority of hazardous and medical waste incinerators are operated commercially, but their numbers and locations are limited.

Whole carcasses, carcass portions, and associated material can be completely burned and reduced to ash in a fixed incinerator. Air and water emission controls are typically required to meet stringent environmental standards. Generally, fixed incinerators are more costly than other disposal options. Because fixed incinerators will not likely be located in close proximity to most poultry production facilities, leakproof transportation to the incinerator must be furnished and transportation vehicles must be disinfected. Health and safety of workers may not be a big issue for hazardous and medical waste incinerators because workers are generally trained and their health is already monitored to deal with dangerous materials. However, some additional training and health monitoring may be required.

Mobile Air Curtain Incinerators



Mobile air curtain incinerators, such as this one, can be used to burn carcasses with reduced particulate matter emissions.

Air curtain incinerators were originally designed as a more environmentally friendly alternative to open burning of wood waste by controlling particulate matter. This is accomplished by directing an air curtain across the top of the open firebox, which traps most particulates and causes them to re-burn in the extremely hot area just below the air curtain and just above the burning combustible material. Because of the high operating temperatures (~2,500°F), air curtain incinerators have been used in disaster clean-up where wood wastes as well as animal carcasses needed to be destroyed.

When used to destruct birds infected with avian influenza, fuel (commonly wood) is first loaded onto the base of the incinerator to create a hot fire-base of about two feet. Once the hot base is established, a layer of carcasses is added to the center of the box. After loading carcasses, an equal amount of wood is layered over the carcasses. Complete incineration of the carcasses typically takes about an hour.

The advantages of mobile air curtain incinerators are that they can be taken to the site where the infected poultry were euthanized, which eliminates transportation issues, or they can be set up at a municipal solid waste (MSW) landfill. The disadvantages of air curtain incinerators include the limited availability of equipment, the requirement for wood material as fuel, the process is affected by inclement weather, and the lack of environmental controls on air emissions. In addition, on-site personnel must be trained in the operation of the incinerator and be protected from exposure to the viruses, ash generated must be disposed of safely, and equipment used to handle the carcasses must be decontaminated.

Waste-To-Energy Facilities

Waste-to-energy (WTE) facilities combine thermal destruction of waste with energy recovery. These incinerators typically have a waste storage pit, a crane for charging the combustion box, a combustion chamber, a heat recovery system, an ash-handling system, and an air pollution control system. The operating temperatures for WTE facilities are 1,800°F to 2,000°F.

The advantage of WTE facilities is that temperatures and retention times in the combustion chamber are sufficient to deactivate the avian influenza virus. Also, these facilities allow for an immediate expanded capacity in a crisis because

they currently are in operation (i.e., 88 facilities operating in 26 states). The disadvantages of WTE facilities are that they may not be available for emergency situations because of the demands of normal use, they may not be licensed to accept poultry carcasses, they require leakproof transportation to the facility and disinfection of transport vehicles, the disinfection of interior portions of the facility are problematic, and facility workers are not likely to be trained to handle the infected material and their health is not typically monitored.

Municipal Solid Waste Landfills

MSW landfills are highly engineered disposal facilities that can accept household waste, non-hazardous sludge, industrial solid waste, and construction and demolition debris. MSW landfills must obtain a permit and comply with federal or equivalent state regulations that ensure environmental protection.



Municipal solid waste landfills will likely play a significant role in the disposal of animal carcasses because they are located throughout the U.S. and already have in place environmental protections.

Typically, MSW landfills have experience in properly managing special wastes and, therefore, are potentially capable of properly managing avian influenza infected carcasses and associated materials. MSW landfills were the primary disposal method for low pathogenic avian influenza infected carcasses in the past without causing environmental problems or further spread of the disease; however, these outbreaks were not the highly pathogenic H5N1 virus.

The acceptance of avian influenza infected material at an MSW landfill must be through prior facility notification such that a pit within the existing waste can be prepared (i.e., similar to asbestos waste). Once the pit is prepared, avian influenza infected materials are off-loaded from transportation vehicles directly into the pit and immediately covered with existing waste or soil to prevent the spread of the virus. The location of the pit containing the diseased material is noted on site maps so that the installation of gas wells or other disturbances to the waste material are avoided.

The primary advantage of MSW landfills is that they are operated, designed, and monitored in a manner that ensures environmental protection and the proper management of carcasses and associated materials infected or potentially infected with avian influenza. The temperatures within the landfill are sufficiently elevated to deactivate the H5N1 virus (i.e., 90-131°F). Additionally, there are approximately 2,000 MSW landfills located throughout the United States potentially resulting in a shorter distance for transport vehicles to travel. Finally, MSW landfills potentially have the capacity to manage a large quantity of carcasses and other materials without affecting other operations.

The main disadvantage of using an MSW landfill is the ability of the facility to accept the infected materials based on its existing permits, which may place restrictions on the types of waste accepted. Also, the acceptance of the carcasses and associated materials depends on the facility manager's agreement to accept the material. As with previous disposal methods, MSW landfill workers will have to be trained and their health monitored when disposing of infected carcasses, leakproof transportation is required to the facility, and proper decontamination procedures for transport vehicles must be supplied at the facility.

Transportation

Most disposal options require special procedures for the transportation of infected carcasses from the point of origin to the disposal site to prevent the spread of the disease. The safe transport of carcasses and associated contaminated materials may be a role for the private solid waste management industry.

In order to transport avian influenza materials, all vehicles need to be cleaned and disinfected before they leave the premises where the infected birds were euthanized and then again after the infected carcasses or associated contaminated materials have been unloaded at the disposal site. The cleaning and disinfection procedures described later must be followed for all personnel, vehicles, and other equipment that contacted or may have contacted infectious materials.



Trucks carrying carcasses must be disinfected at the point of collection and after unloading at the disposal site.

Infected carcasses and associated materials should be transported in leakproof vehicles to contain any fluids and prevent the spread of the avian influenza virus. Vehicles should be enclosed and lined with a heavy-duty plastic liner which can assist in carcass removal from the vehicles. As an alternative, leakproof containers can be used for transportation. Transporters also will need a spill contingency and clean-up plan should an incident occur.

Because government agencies with a role in homeland security consider avian influenza carcasses a potential biosecurity threat, they suggest that government representatives accompany vehicles to the disposal site. However, this may be impractical in cases where a large number of birds are euthanized and need to be sent off-site for disposal.

Worker Protection

Because exposure to infected poultry and their feces or dust contaminated with feces has been associated with human infection, waste management workers must be protected from this exposure to prevent illness. All worker protection programs begin with educating employees about the importance of strict adherence to, and proper use of, personal hygiene (e.g., hand washing) and the use of appropriate personal protective equipment (PPE).

The Centers for Disease Control and Prevention recommends that the PPE of workers responding to an H5N1 avian influenza outbreak include the following equipment:

- ▶ Impermeable gloves, outer clothing, and shoe covers or boots to protect skin surfaces;
- ▶ Safety goggles to protect the mucous membranes of eyes; and
- ▶ Disposable (e.g., N-95, N-99, or N-100) or reusable particulate respirators that worker's fit-test for facial seal.



Workers handling diseased birds must wear proper personal protective equipment such as impermeable gloves, outer clothing, and safety goggles.

All PPE should be cleaned and disinfected before removing and the touching of non-contaminated items and environmental surfaces. Disposable PPE should be properly disposed of in a secure facility (e.g., MSW landfill, WTE facility, etc.). Hand hygiene measures should be performed after removal of PPE (i.e., washing with soap and water for 15-20 seconds or the use of other standard hand-disinfection).

In addition to PPE, unvaccinated workers should receive the current season's influenza vaccine to reduce the possibility of dual infection with avian and human influenza viruses because there is a small possibility that a dual infection could occur and result in re-assortment and the development of a new flu virus that is more easily transmitted by humans. The resultant hybrid virus could be highly transmissible among people and lead to a pandemic.

Workers should also receive an influenza antiviral drug daily for the time period when direct contact with infected poultry or contaminated surfaces occurs and for a period of time afterwards despite the unproven effective-

ness of currently available drugs. The choice of antiviral drug should be based on sensitivity testing whenever possible. In the absence of sensitivity testing, a *neuraminidase* inhibitor (*oseltamavir*) is the first choice since the likelihood is smaller that the virus will be resistant to this class of antiviral drugs than to *amantadine* or *rimantadine*.

Employers should instruct workers to be vigilant for the development of fever, respiratory symptoms, or conjunctivitis (i.e., eye infections) for one week after their last exposure to avian influenza-infected or exposed birds or to potentially avian influenza-contaminated environmental surfaces. Individuals who become ill should seek medical care and notify their company health care provider that they may have been exposed to avian influenza. In addition, employees should notify their health and safety representative. Individuals who become ill should be advised to stay home until 24 hours after resolution of a fever unless an alternative diagnosis is established or diagnostic test results indicate the patient is not infected with the influenza A virus.

Disinfection

With the off-site carcass and associated material disposal options, cleaning and disinfection of carcass transportation and disposal equipment and PPE will be needed to prevent the spread of the virus. The U.S. Environmental Protection

Agency (EPA) currently registers pesticide products, including disinfectants. Some 100 disinfectant products are registered and intended for use against avian influenza A viruses on hard, non-porous surfaces (www.epa.gov/pesticides/factsheets/avian_flu_products.htm). These products are typically used by the poultry industry to disinfect facilities. Typically, product labels include information on waste such as: veterinary premises, poultry houses, farm premises and equipment, and other industrial and institutional settings. In addition, the labels indicate whether the product is effective against “avian influenza A.”

Although there are not antimicrobial products registered specifically against the H5N1 subtype of the avian influenza A virus, EPA believes that the currently registered avian influenza A products will be effective against the H5N1 strain and other strains.

The U.S. Department of Agriculture (USDA) provides guidance for the disinfection of poultry facilities. USDA's guidelines can be found at www.fsis.usda.gov/OPPDE/rdad/frpubs/san_guide_app.htm.

Conclusion

Despite the dire predictions of public health officials, the H5N1 avian influenza virus has not yet reached the U.S. Whether or not the virus infects North American poultry flocks or acquires the traits necessary to become an easily transmitted human pathogen remains to be seen. However, experts worldwide believe that the H5N1 virus has the near term potential to create a global problem.

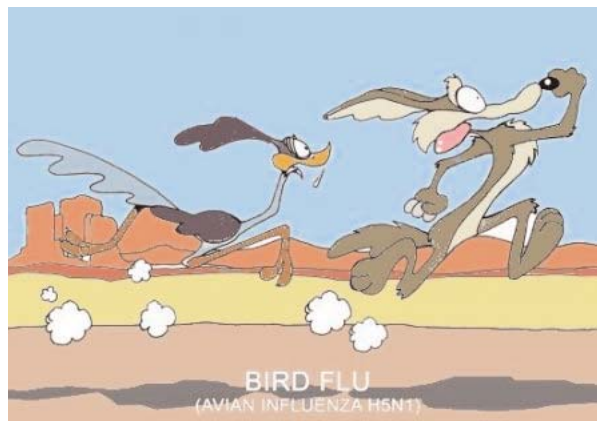
Waste management companies need to decide soon what role they are going to play in the management of infected carcasses and associated materials, including consideration of transportation and disposal issues as well as whether their employees are willing to handle these types of materials. Also, all companies should consider contingency plans on how they will continue normal operations if a human pandemic affects their workforce.

A number of useful websites provide additional help on planning for the management of avian influenza and a pandemic should it occur. The following internet sites provide useful information on avian influenza and agency action:

- ▶ www.cdc.gov/flu/avian
- ▶ www.pandemicflu.gov
- ▶ www.epa.gov/pesticides/factsheets/avian.htm
- ▶ www.osha.gov/dsg/guidance/avian-flu.html
- ▶ www.who.int/crs/disease/avian_influenza
- ▶ www.businesscontingency.com

Sick Humor

Discussions on important waste management issues are never without humor as shown here in these pictures. The first is from a slide used in a presentation on avian influenza with an infected Donald Duck at a Disney World Resort overseas. The second shows an infected wild bird, Warner Brothers' Road Runner, chasing the Coyote who is hoping to escape exposure to the H5N1 virus. However, in reality, this is a very serious issue.





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